State of California
The Resources Agency

CALIFORNIA DEPARTMENT OF FISH AND GAME

REPORT TO THE FISH AND GAME COMMISSION ON THE STATUS OF

SCOTTS VALLEY POLYGONUM (*POLYGONUM HICKMANII*)

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Status Report 04-01

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REPORT TO THE FISH AND GAME COMMISSION
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I. EXECUTIVE SUMMARY

INTRODUCTION

This report has been prepared in response to a petition received by the Fish and Game Commission (Commission) from Dr. Grey Hayes on January 9, 2003, to list Scotts Valley polygonum (*Polygonum hickmanii*) as Endangered under the California Endangered Species Act (CESA). On June 19, 2003, pursuant to Section 2074.2 of the Fish and Game Code, the Commission found that the petition contained sufficient information to determine that the petitioned action may be warranted, and designated Scotts Valley polygonum a candidate species. In accordance with Section 2074.6 of the Fish and Game Code, the California Department of Fish and Game (Department) undertook a 12-month review of this petition.

Based on the best scientific information available, the Department evaluated whether or not the petitioned action should be taken. This report presents the results of the Department's review and analysis, and recommends that Scotts Valley polygonum be added to the list of endangered species. It also includes a preliminary determination of the habitat that may be essential to the continued existence of the species, and suggests management activities and other recommended recovery actions.

The Department contacted the landowners on whose property Scotts Valley polygonum is known to occur, adjacent landowners, management agencies and other affected and interested parties to notify them of Scotts Valley polygonum's candidacy (Appendices A and B). Public notices were published in the Santa Cruz Sentinel and the Scotts Valley Banner newspapers on September 24, 2003. As of June 6, 2004, no public comment letters had been received in response to the notices.

Two outside independent experts (peer reviewers) commented on the draft Report to the Fish and Game Commission on the status of Scotts Valley polygonum (Appendix C); both concurred with the Department's recommendation that Scotts Valley polygonum warrants listing as endangered. The report was also informally peer reviewed by two Department staff.

FINDINGS

The worldwide distribution of Scotts Valley polygonum consists of two populations in Scotts Valley, Santa Cruz County, California. The populations are less than one mile apart and occupy a combined total area of less than one acre. The total number of plants at the populations has ranged from 200-400 plants to 3500 plants from year to year. Both populations of Scotts Valley polygonum are threatened by habitat loss and

degradation and other human-related activities. Competition with non-native plants may be a factor affecting the viability of the populations. Scotts Valley polygonum is also at high risk of extinction due to the small number of plants at each occurrence and the limited extent of available habitat. The level and degree of present and potential threats to this species support the Department's recommendation to list Scotts Valley polygonum as endangered.

Scotts Valley polygonum is a small, erect, taprooted, annual plant in the buckwheat family (Polygonaceae). It grows 1-2 inches (2-5 cm) tall and can be either single stemmed or branched near the base. Each plant produces one or more single white flowers with bright orange or pink anthers that bloom from late May to August (Hinds and Morgan 1995). Scotts Valley polygonum occurs in coastal prairie grasslands in northern Scotts Valley, Santa Cruz County, California, approximately seven miles (12 km) from the coast, at an elevation of 700-800 feet (215-246 m). Within these coastal prairie grasslands, Scotts Valley polygonum grows in gently sloping to nearly level patches of exposed bedrock (Santa Cruz mudstone or Purisima sandstone) overlain with a very thin layer of soil. These pockets of exposed bedrock, often referred to as "rock outcrops", support an array of specially-adapted native plants, including several rare endemics. Scotts Valley polygonum only occurs within these relatively bare microhabitats with little or no competition from other plants.

The total number of plants observed in any given year since its discovery in 1990 has ranged from 200-400 plants to almost 3500 plants. The most recent surveys for the species conducted in 2003 found a total of 604 plants at all sites. Because Scotts Valley polygonum was discovered so recently, information on its abundance prior to 1990 is not available. Fluctuations of population numbers by an order of magnitude or more from year to year are not unusual for annual plants and do not necessarily reflect the health of the population. Such fluctuations could be due to environmental factors such as rainfall or temperature. Because the numbers of plants vary greatly from year to year, habitat quality and quantity, and the degree and nature of the threats to the habitat, are more useful and accurate indicators for the status of the species.

The two occurrences of Scotts Valley polygonum are located on three privately-owned parcels. At each occurrence, the Scotts Valley polygonum plants are grouped in one or more discrete patches within distinct rock outcrop areas. Each patch of plants ranges in size from 5 ft by 5 ft (1.5 m by 1.5 m) to 50 ft by 30 ft (15m by 9 m). The first occurrence (EO1[1]) is located entirely on the Polo Ranch property. A housing development is currently being planned for this site. The second occurrence, Glenwood Hills (EO2) is made up of five patches of plants located on two adjacent parcels which are owned and managed by two separate landowners: the Scotts Valley School District (EO2a) and the Salvation Army (EO2b). At the School District site (EO2a), one patch of plants is located approximately 60 feet (18 m) from the edge of the school playing fields, in a 9-acre "preserve area". Although this area is referred to as a "preserve area", its

[1] EO = Element Occurrence: a population/occurrence of the species as defined by the Department's California Natural Diversity Database (CNDDB)

long-term legal protection has not been secured. Four patches of plants occur on the Salvation Army site (EO2b).

Principle threats to Scotts Valley polygonum include direct and indirect impacts due to development and habitat fragmentation, disturbance due to illegal off-road vehicle use and other human activities, competition with non-native weeds, and chance events due to the small number of plants and limited extent of occupied area.

Construction Activities. Recent construction of Scotts Valley High School and the Recycled Water Distribution Plant at the Salvation Army site resulted in the destruction and fragmentation of Scotts Valley polygonum habitat. At the school district site 0.33 acre of rock outcrop areas were eliminated by construction, and the existing Scotts Valley polygonum plants are now located approximately 60 feet (18 m) from the edge of the school playing fields (BRG 1999b). At the Salvation Army site eight rock outcrop areas were eliminated by construction, and the existing plants are now directly downslope from a new road (BRG 1999a). A housing development is currently in the planning stages for the Polo Ranch site (EO1), and may result in direct or indirect impacts to Scotts Valley polygonum due to habitat destruction, fragmentation, and disturbance.

Habitat Fragmentation. The proximity of Scotts Valley polygonum plants to developed areas subjects them to indirect impacts, such as changes in surface hydrology and water quality due to application of herbicides, pesticides, and dust-reducing substances to adjacent areas; invasion of non-native plants; soil disturbance, compaction, and siltation; and possible vandalism. Loss of surrounding habitat may also result in the loss of insect pollinators or seed dispersal vectors. Habitat fragmentation and inadequate design of preserve areas threaten the continued existence of the species through the disruption of ecological functions, which may lead to hydrologic changes; non-native plant invasions; and disruption of fire regimes, soil integrity, seed dispersal mechanisms, nutrient cycling, and plant-pollinator interactions.

Off-road Vehicle Use. Illegal off-road vehicle use is an ongoing problem, and can result in the damage or death of plants when they are run over, as well as cause soil disturbance, compaction, or erosion. Heavy off-road vehicle use is occurring at the Polo Ranch site (EO1) and the Salvation Army site (EO2b). Although a “no trespassing” sign is posted at the Polo Ranch site, off-road vehicle activities are a continuous problem because of an inability to lock a main access gate due to a private property right of way, the isolated nature of the property, and infrequent law enforcement patrol. Off-road motorbike and dirt bike trespass is a problem on the Salvation Army property (EO2b) despite fencing in the area, and there appears to be no enforcement. A dirt bike trail runs directly through one of the Scotts Valley polygonum habitat areas at this site, and although current activity does not yet appear to have significantly impacted the species, it is likely that damage to this site will occur over time. Soil disturbance and compaction by human, bicycle, and pet traffic are potential threats in the School District preserve area (EO2a), which has been subject to minor human disturbances, including students traversing the site and residents using the area for golf practice (BRG 2002).

Competition. Competition with non-native plants for light, water, nutrients, and/or space may impact Scotts Valley polygonum. Field observations show that Scotts Valley polygonum appears to require relatively bare microhabitats with little or no competition from other plants in order to survive and reproduce. Although the rock outcrop areas where Scotts Valley polygonum occurs generally do not support abundant non-native species, the tall grasses found in nearby areas can negatively impact Scotts Valley polygonum by causing shading that would not normally be present, as well as contributing to the accumulation of thatch. Shading can inhibit the germination and growth of seedlings, and thatch buildup can change microhabitat conditions and suppress stored soil seedbanks.

Risk of Extirpation. The small number of plants and the small area of occupied habitat increase the risk of extirpation or extinction due to chance events. Total loss of one or more Scotts Valley polygonum populations could potentially be caused by wildfire, a new disease or insect pest, or failure or loss of pollinators. The reproductive potential and reproductive requirements of Scotts Valley polygonum are unknown at this time, and therefore the ability of the species to compensate for these impacts is also unknown. Population geneticists have determined that small populations are susceptible to genetic drift, loss of genetic variation that can compromise their long-term survival. In addition, small populations may be less effective in attracting the pollinators necessary for their reproductive success.

Scotts Valley polygonum is Federally-listed as Endangered; however, listing under the Federal Endangered Species Act does not provide Scotts Valley polygonum adequate protection because all occurrences of the species are on private lands where U.S. Fish and Wildlife Service has limited jurisdiction. A federal nexus would be required in order for the species to receive any protection under the federal act. Because both populations of Scotts Valley polygonum occur on private land, and legally binding conservation agreements have not been executed at any of the sites, the species is currently afforded no guaranteed long-term protection.

PEER REVIEW

Two outside independent experts (peer reviewers) commented on the draft Report to the Fish and Game Commission on the status of Scotts Valley polygonum (Appendix C). The peer reviewers were selected based on their scientific expertise as related to this species or its habitat, and their ability to offer an objective review. The Department solicited comments on completeness and accuracy of the information presented in the report, and whether the conclusions reached are reasonable based on this information.

Both peer reviewers concurred that Scotts Valley polygonum warrants listing as endangered. Peer reviewer comments included the following:

> Dr. Karen Holl (University of California, Santa Cruz) found that the report is thorough and the evidence presented strongly supports the recommendation to

list the species as endangered. She stated that the information presented in the report is consistent with her knowledge of the system, and she concurred with the recommended management actions. She noted that ongoing monitoring will be particularly critical in the management of the species. Dr. Holl found that it will be essential to protect both of the two populations of this species, and emphasized that it will also be necessary to protect a buffer area around the populations to minimize effects of fragmentation.

Dr. Jodi McGraw (University of California, Berkeley) found that the report provides a thorough assessment of available knowledge of the biology of the species and clearly outlines the causes and consequences of its rarity. She concurred that the species warrants listing as endangered and strongly supported the findings in the report. Dr. McGraw noted that the species has exceedingly small population sizes, is of the rarest type of species, and its persistence is clearly threatened by habitat destruction, habitat degradation, and genetic erosion. She emphasized that the small size of the populations leave the species extremely vulnerable to extinction due to natural occurrences such as drought, outbreak of herbivores or fungal pathogens, or insufficient cues for germination or seedling establishment, as well as anthropogenic events such as off-highway vehicle use. Dr. McGraw noted that a comprehensive recovery strategy for the species will require research to determine its ecological requirements and test potential management techniques, and she strongly recommended that the recovery actions outlined in the report be enacted expeditiously.

In addition, Dr. McGraw described the results of some of her own research on related species within the same region, which may provide insight into the conservation needs of Scotts Valley polygonum. Her research on another endemic Polygonaceae species found that its seed storage is very limited. She cautioned that not all annual plants have a seed bank, and those species without a seed bank are especially vulnerable to extinction because their persistence requires that successive cohorts of plants establish, survive, and reproduce each year. It is unknown whether Scotts Valley polygonum has a seed bank. Her research has also shown that exotic plants restrict the distribution of two other endemic plants in the region. She stated that like other narrow endemic plants restricted to rock outcrops, Scotts Valley polygonum is likely a poor competitor. Exotic plants may restrict the distribution of the species, and competition with exotics could result in negative population growth that leads to extirpation. She recommended that small scale experimental research be used to examine the effects of potential management techniques to reduce exotic plant competition on Scotts Valley polygonum's demographic performance.

Appendix C includes a summary of peer review comments and copies of the peer reviewers' comment letters.

CONCLUSION

Due to its extreme rarity and restricted nature, the Department concludes that Scotts Valley polygonum in danger of becoming extinct in the absence of special protection and management efforts; therefore, listing as endangered is warranted at this time.

There are only two populations of Scotts Valley polygonum in Scotts Valley, Santa Cruz County, California, less than one mile apart and occupying a total area of less than one acre. The total number of plants in the populations has ranged from 200-400 plants to 3500 plants from year to year. The two populations of Scotts Valley polygonum are threatened by habitat loss and degradation and other human-related activities. Competition with non-native plants may also be a factor affecting the viability of the populations. Scotts Valley polygonum is vulnerable to random natural and anthropogenic effects due to the small size of the populations and limited extent of occupied habitat.

RECOMMENDATIONS

Petitioned Action

The Department recommends that the Commission:

1. Find that the petition to list Scotts Valley polygonum (*Polygonum hickmanii*) as endangered is warranted at this time.

2. Publish notice of its intent to amend Title 14 CCR 670.2 to add Scotts Valley polygonum (*Polygonum hickmanii*) to its list of endangered species.

Recovery And Management Actions

The Department recommends the following actions. The Department should:

1. Continue to work with landowners, project proponents, local lead agencies and other interested parties to secure Scotts Valley polygonum and its habitat. Current management and land-use plans should be properly finalized and implemented. The 4.4 acre conservation easement on the Salvation Army site should be finalized, and efforts should be made to secure long-term legal protection of the Scotts Valley School District “preserve area”. The Department should work with the City of Scotts Valley and landowners during the development and consideration of any proposed project at the Polo Ranch site, to ensure the protection and management of the Polo Ranch population. Preservation of a matrix of occupied and potentially suitable habitat will help allow the species to survive stochastic events and respond to varying changes in disturbance regimes. In her review, Dr. Holl emphasized that it is necessary to

preserve not only the exact locations where Scotts Valley polygonum is found, but also a buffer area around the populations to minimize effects of fragmentation.

2. In cooperation with the California Native Plant Society and other interested parties, conduct additional focused surveys in areas of potentially suitable habitat in the Scotts Valley area, in an attempt to locate additional populations.

3. Consult with scientific experts to obtain the best available technical expertise to inform conservation and management decisions regarding Scotts Valley polygonum; and work with the landowners, local agencies and interested parties to develop a conservation strategy.

4. Coordinate with local fire departments to prevent disturbance during emergency fire response.

5. Work with the landowners to develop long-term monitoring programs at locations where needed, and to ensure that current long-term monitoring programs are adequate to provide data on the health of Scotts Valley polygonum populations that will help guide further management actions and conservation methods. Extant populations should be monitored yearly and information submitted to the Department's California Natural Diversity Database.

6. Develop and implement adaptive management strategies in cooperation with landowners and land managers. The adaptive management programs should respond to identified and potential threats to the species, including public access, off-road vehicle use, soil compaction and disturbance, increased erosion, trampling, competition, and wildfire.

7. Initiate fundamental research on aspects of the biology and ecology of Scotts Valley polygonum necessary to help guide management and recovery efforts, and seek funding to support investigations. Potential research needs identified to date include: reproductive and pollination ecology; factors determining seed viability and reproductive success, including seed dispersal and herbivory; habitat requirements of potential pollinators and dispersal agents; plant demographics; habitat and soil requirements; response to competition and management methods to reduce competition with non-native plants; long-term population trends; and genetic diversity of the species.

REPORT TO THE FISH AND GAME COMMISSION

ON THE STATUS OF

SCOTTS VALLEY POLYGONUM
(*POLYGONUM HICKMANII*)

II. INTRODUCTION

PETITION HISTORY

On January 9, 2003, the Fish and Game Commission received a petition from Dr. Grey Hayes to list Scotts Valley polygonum (*Polygonum hickmanii*) as Endangered under the California Endangered Species Act (CESA). The California Department of Fish and Game (Department) reviewed the petition and recommended that the Commission accept it for further consideration, as provided for in Section 2074.6 of the Fish and Game Code. On June 19, 2003, the Commission accepted the Department's recommendation to designate Scotts Valley polygonum a candidate species. That action initiated a 12-month review period, as provided for in CESA, during which the Department was directed to review the petition and other information and provide a written report to the Commission containing findings and recommendations.

This report presents the results of the Department's review and analysis, and a recommendation to the Commission, based upon the best scientific information available, as to whether or not the petitioned action is warranted. It also includes a preliminary determination of the habitat that may be essential to the continued existence of the species, and suggests management activities and other recommended recovery actions.

DEPARTMENT REVIEW AND PUBLIC RESPONSE

During the review period Department staff evaluated available literature and other information and conducted interviews with knowledgeable individuals. Department staff also conducted site visits prior to and during candidacy. The Department contacted the petitioner, three landowners on whose property Scotts Valley polygonum is known to occur, 72 adjacent landowners, 11 management agencies and other affected and interested parties to notify them of the candidacy of the species (Appendices A and B). Public notices were published in the Santa Cruz Sentinel and the Scotts Valley Banner newspapers on September 24, 2003. As of June 6, 2004, no public comment letters had been received in response to the notices.

Two outside independent experts (peer reviewers) commented on the draft Report to the Fish and Game Commission on the Status of Scotts Valley polygonum (Appendix C). The peer reviewers were selected based on their scientific expertise as related to this species or its habitat, and their ability to offer an objective review. The Department

solicited comments on completeness and accuracy of the information presented in the report, and whether the conclusions reached are reasonable based on this information. Both peer reviewers concurred with the Department's recommendation that Scotts Valley polygonum warrants listing as endangered. Peer review comments are included in Appendix C.

This report was also informally peer reviewed by two Department staff.

III. FINDINGS

DESCRIPTION AND TAXONOMY

Species Description

Scotts Valley polygonum is a white-flowered annual plant in the buckwheat family (Polygonaceae). The small, erect, taprooted herb grows 1-2 inches (2-5 cm) tall and can be either single stemmed or branched near the base (Figures 1 and 2). The linear-shaped leaves are 0.04-0.06 inch (1-1.5 mm) wide, 0.2-1.4 inch (0.5-3.5 cm) long and sharply pointed at the tip. The single flowers, which bloom from late May to August, are found in the axils of the bracteal leaves (i.e., the axis between the stem and a flower-subtending leaf). The white flowers consist of two outer and three inner white tepals (i.e., petal-like structures) contrasted with bright orange or pink anthers. (Hinds and Morgan 1995).

Like many California annuals, Scotts Valley polygonum is inconspicuous during the fall and winter. In the spring, seedlings that have germinated in response to winter rains begin to emerge from the soil, growing slowly until flowering in late spring and summer. By the end of the summer season, seeds have been produced and the life cycle is complete. After the seeds disperse, they lay dormant in the soil until germination is triggered in the future by the appropriate combination of soil, temperature and moisture conditions.

Taxonomic History

Scotts Valley polygonum, also known as Hickman's knotweed and Hickman's smartweed, is a member of the genus *Polygonum*, in the buckwheat family (Polygonaceae). *Polygonum*, Greek for "many knees", describes the swollen nodes generally characteristic of this genus. The genus comprises approximately three hundred species of various size classes and life history characteristics distributed worldwide, including annuals, perennials, shrubs, and vines, which may be prostrate, erect, climbing, or floating (Hickman 1993). In California, twenty-five native *Polygonum* species are known, which range from small annuals to shrubs, and vary in abundance and distribution from common to rare (Hickman 1993).

Figure 1. Scotts Valley polygonum (*Polygonum hickmanii*), close-up. *Photo by Randy Morgan*

Figure 2. Scotts Valley polygonum (*Polygonum hickmanii*) in flower. *Photo by Mary Ann Showers*

Scotts Valley polygonum is the most recently described species of *Polygonum* in California. Mr. Randall Morgan, a Santa Cruz area ecologist and local expert, first noticed the uniqueness of Scotts Valley polygonum in 1990, and collected it to verify its identification in 1993. Further review and investigation confirmed that it was a distinct species that had never before been collected or described. In 1995, it was officially described as a species new to science (Hinds and Morgan 1995). Scotts Valley polygonum (*Polygonum hickmanii*) was named for Dr. James C. Hickman, an expert on the genus *Polygonum*. Dr. Hickman examined the Scotts Valley polygonum specimens that Mr. Morgan collected in the early 1990's and concurred that it was a distinct taxon, but died before coauthoring the publication describing the species (Hinds and Morgan 1995). A review of the genus was recently completed by *Polygonum* experts Drs. Harold Hinds and Mihai Costea for the Flora of North America project, and both agreed that Scotts Valley polygonum should be retained as a distinct species in the upcoming publication of this reference (Freeman, pers. comm.).

ECOLOGICAL INFORMATION

Information regarding the ecological requirements of Scotts Valley polygonum is limited. All known occurrences of the species are found within northern Scotts Valley, Santa Cruz County, California, approximately seven miles (12 km) from the coast, at an elevation of 700-800 feet (215-246 m) (Figure 3). The coastal climate in this habitat is highly influenced by the nearby ocean, with a mean summer temperature of 67º F (20º C), a mean winter temperature of 49º F (9º C), an average yearly rainfall of 41 inches (104 cm), and frequent fog.

Scotts Valley polygonum occurs in coastal prairie grasslands on wave-cut coastal terraces underlain by uplifted marine sediment substrates (Figure 4). CNDDB (2004) reports describe the habitat at the site as valley and foothill grassland, vernally moist due to runoff. Within these grasslands, Scotts Valley polygonum grows in gently sloping to nearly level patches of exposed bedrock (Santa Cruz mudstone or Purisima sandstone) overlain with a very thin layer of soil (Figure 5). The soils in these areas have been described as "Purisima sandstone or mudstone with a thin soil layer", "exposed bedrock (Purisima formation)", "a shallow layer of pulverized mudstone over bedrock" and "a shallow layer of decomposed bedrock." (CNDDB, 2004). These pockets of exposed bedrock, often referred to as "rock outcrops", are scattered in a mosaic within the deeper-soiled coastal prairie grasslands of Scotts Valley. Due to their greater water-holding capacity and current management practices, the deeper-soiled grasslands tend to support primarily non-native annual grass species. The thin-soiled rock outcrops, in contrast, form patches of winter-saturated/summer-dry habitat that non-native grasses are unable to tolerate. The relatively bare, crusty soil surface of the rock outcrops clearly stands out, appearing like "islands" within the loose, sandy soils and dense cover of vegetation of the surrounding grassland (Figures 6 and 7). These "islands" have been nicknamed the "wildflower fields" because they support an array of specially-adapted native plants, including several rare endemics. Scotts Valley polygonum only occurs within these relatively bare microhabitats with little or no competition from other plants.

Figure 3. Map of the distribution of Scotts Valley polygonum

Figure 4. Coastal prairie grassland in springtime with surrounding shrubs. *Photo by Melanie Gogol-Prokurat*

Figure 5. Coastal grassland and rock outcrop area in springtime. Note the crusty, bare surface of the rock outcrop. *Photo by Melanie Gogol-Prokurat*

Figure 6. Scotts Valley poygonum habitat in springtime: rock outcrop within grassland. *Photo by Melanie Gogol-Prokurat*

Figure 7. Scotts Valley polygonum habitat in summer: rock outcrop within dry grassland. *Photo by Mary Ann Showers.*

Little is known about the reproductive ecology of Scotts Valley polygonum. Many species closely related to Scotts Valley polygonum are self-pollinating, and the small size and lack of showiness of the Scotts Valley polygonum plants and their flowers are indicative of a self-pollinating plant species (Morgan, pers. comm. 2003). However, a small, unidentified sphecid wasp was observed visiting a Scotts Valley polygonum individual, although its role as a pollinator is unknown. If Scotts Valley polygonum requires insect pollination, then maintaining pollinator assemblages and sufficient pollinator foraging areas would be very important for polygonum reproduction.

It is not known whether Scotts Valley polygonum has a persistent soil seed bank. In her review, Dr. McGraw noted that although it is often assumed that many annual plants have a seed bank, not all plant species have seed banks. Her research on a related Polygonaceae species found that seed storage in that species was very limited. If Scotts Valley polygonum does not have a dormant store of seed in the soil, it may be especially vulnerable to extinction because its persistence would rely on the successful establishment and reproduction of plants each year. Observations indicate that seed production in healthy Scotts Valley polygonum plants ranges from several dozen to up to 200 seeds per plant, while depauperate plants may produce few or no seeds (Morgan, pers. comm. 2003). Due to the recent discovery of this species, and the small population sizes, seed has not been collected for storage or propagation.

Scotts Valley polygonum occurs most often with Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*), a Federally endangered species also endemic to the specialized rock outcrop habitat patches in Santa Cruz County. Other rare or locally significant species occurring in association with Scotts Valley polygonum include the State-listed endangered San Francisco popcorn flower (*Plagiobothrys diffusus*), the Federally-listed endangered Ohlone tiger beetle (*Cicindela ohlone*), and the rare plant species Mount Diablo cottonweed (*Stylocline amphibola*) and Gray's clover (*Trifolium grayi*). Other native herbs associated with Scotts Valley polygonum include goldfields (*Lasthenia californica*), sandwort (*Minuartia douglasii*), California sandwort (*M. californica*), gilia (*Gilia clivorum*), owl's clover (*Castilleja densiflora*), sky lupine (*Lupinus nanus*), brodiaea (*Brodiaea terrestris*), and coast tarplant (*Hemizonia corymbosa*).

DISTRIBUTION AND ABUNDANCE

Range

Scotts Valley polygonum is endemic to Scotts Valley, Santa Cruz County; it is found nowhere else in the world. It is known from only two occurrences, less than one mile apart and occupying a total area of less than one acre. Because the species was first discovered in 1990, little is known about its historical range and distribution. Development of the areas surrounding the currently known occurrences, including the City of Scotts Valley and Highway 17, may have removed habitat that historically supported the species (Figure 8). In addition, undeveloped habitat in the vicinity of the currently known occurrences may once have provided suitable habitat for Scotts Valley

1962 2000

Figure 8. Aerial photographs of the City of Scotts Valley from 1962 and 2000. Note the change in developed area. Current Scotts Valley polygonum habitat is outlined in red.

polygonum, but is now dominated by non-native plants. However, due to the apparent association of Scotts Valley polygonum with the unique rock outcrop soils in the Scotts Valley area, as well as the lack of herbarium specimens or other records of the species from other areas in the state, it is likely that the species has always been limited in distribution to the grasslands within and around Scotts Valley.

Occurrences

The two occurrences of Scotts Valley polygonum are located on three privately-owned parcels. At each occurrence the Scotts Valley polygonum plants are grouped in one or more discrete patches located within distinct rock outcrop areas (Figure 9). Each patch of plants ranges in size from 5 ft by 5 ft (1.5 m by 1.5 m) to 50 ft by 30 ft (15m by 9 m).

EO1 – Polo Ranch

The first occurrence (EO1[2]) is located entirely on the Polo Ranch property. This population is located just east of Highway 17 and north of Navarra Road, in northern Scotts Valley, on private land owned by Lennar Communities/Greystone Homes. A housing development is currently being planned for this site.

EO2 – Glenwood Hills

The second occurrence, Glenwood Hills (EO2) is located north of Casa Way and west of Glenwood Drive in northern Scotts Valley, less than one mile northwest of Polo Ranch (EO1). It is made up of five patches of plants located on two adjacent parcels, one owned by the Scotts Valley School District, and one owned by the Salvation Army. Because this occurrence is located on two adjacent parcels, which are owned and managed by two separate landowners, these two portions of the occurrence will be differentiated for the purpose of this document as the Scotts Valley School District occurrence (EO2a) and Salvation Army occurrence (EO2b).

EO2a – Scotts Valley School District

This portion of the occurrence consists of one patch of plants occurring on land owned by Scotts Valley School District. The plants are located approximately 60 feet (18 m) from the edge of the school playing fields, in a 9-acre “preserve area” adjacent to Scotts Valley High School.. The “preserve area” provides habitat for several rare species, including the Federally-listed endangered Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*), the State-listed endangered San Francisco popcorn flower (*Plagiobothrys diffusus*), the Federally-listed endangered Ohlone tiger beetle (*Cicindela ohlone*), as well as Scotts Valley polygonum. However, although this area is

[2] EO = Element Occurrence: a population/occurrence of the species as defined by the Department’s California Natural Diversity Database (CNDDB)

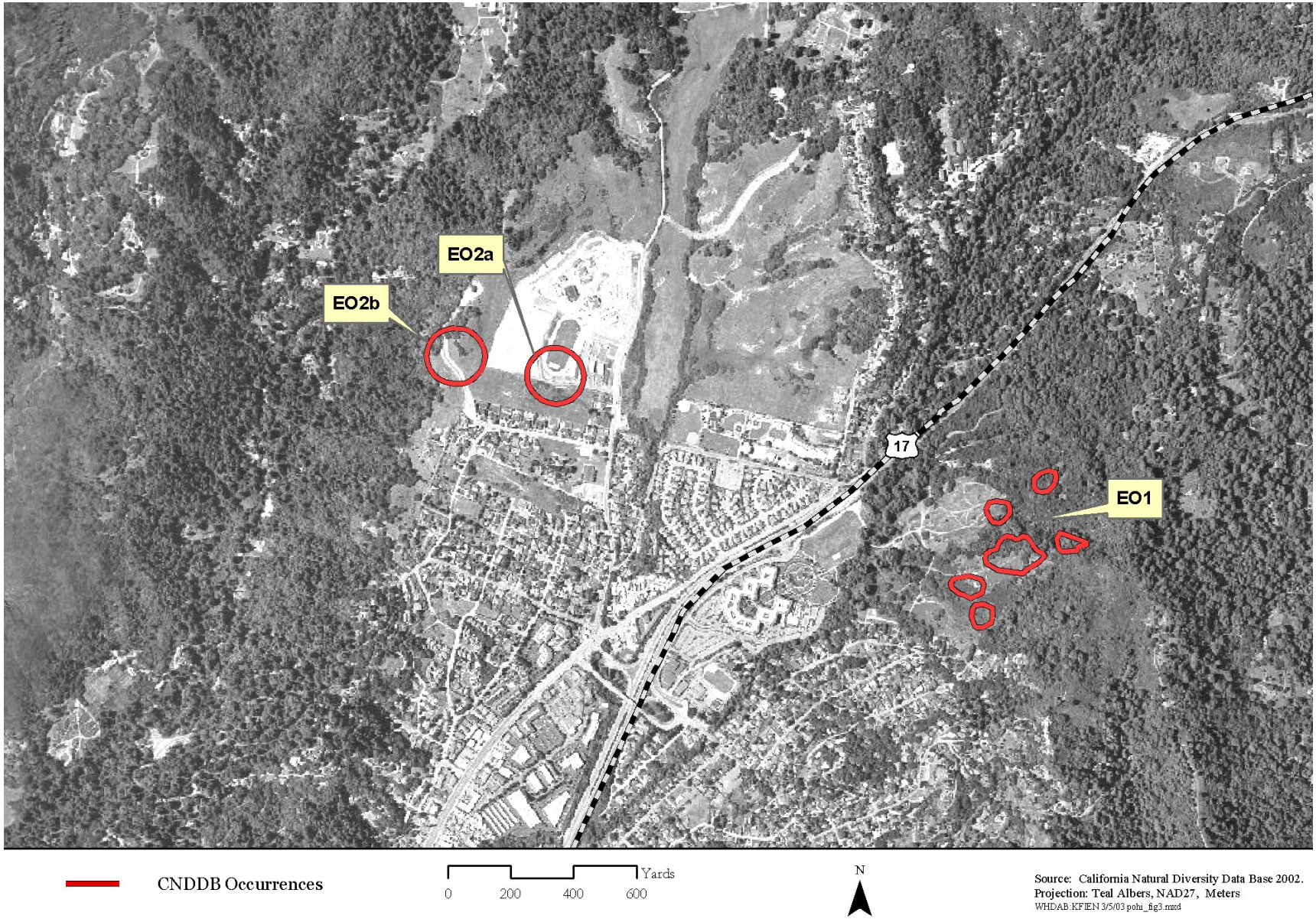

Figure 9. Aerial photograph of current Scotts Valley polygonum occurrences.

referred to as a “preserve area”, its long-term legal protection has not been secured.

EO2b – Salvation Army
This portion of the occurrence consists of four patches of plants occurring on land owned by Salvation Army, approximately 690 feet (210 m) west of the plants on Scotts Valley School District Land (EO2a). A 4.4 acre conservation easement to protect this habitat area in perpetuity was drafted in 1999, but the parties were unable to come to a consensus on the terms of the easement, and it has not been finalized.

Population estimates

Because Scotts Valley polygonum was discovered so recently, information on its abundance prior to 1990 is not available. Since its discovery in 1990, the total number of plants observed in any given year has ranged from 200-400 plants to almost 3500 plants (Table 1). This information includes both exact counts of numbers of plants as reported to the CNDDB or elsewhere, as well as general estimates of population numbers based on local botanists’ recollections of their observations. Exact counts of plants at all populations are available for 1998 and 2003, when a total of 3412[3] plants and 604 plants were counted, respectively.

	1990	**1991**	**1992**	**1993-1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Polo Ranch (EO1)	300	*	*	*	2140	1259	*	*	*	*	294
School District (EO2a)	*	50	*	*	*	153	*	120	150	140	88
Salvation Army (EO2b)	50	*	79	*	*	2000	*	200	225	200	222

Table 1. Number of Scotts Valley polygonum plants observed at each site since 1990.
*no survey information available

At Polo Ranch (EO1) a total of twelve patches of plants have been identified, and surveys conducted in 1990, 1997, 1998, and 2003 found between three and nine of these patches occupied in a given year. The total number of plants in all patches ranged between approximately 300 and 2140 per year. The difference in the number of patches and plants observed at this site in different years may be due to variations in

[3] The petition originally stated that the total number of plants seen in 1998 was 5410. On January 30, 2003, the Commission received a letter from the petitioner stating that this value was erroneous, and that the correct number is 3412.

survey methodology; natural fluctuations in the population; or changes in land use affecting the species, such as cessation of grazing or increased off-road vehicle use.

At the School District site (EO2a), surveys since 1991 have found between 50 and 153 plants in one patch. At the Salvation Army site (EO2b), surveys since 1990 have found between 50 and 2000 plants in four patches. In 1998, an estimated 2000 plants were present at the site, while in 2000, only 200 plants were found. The reason for the marked increase and then subsequent decrease in the number of plants at the Salvation Army site is unknown. The Scotts Valley Water District Recycled Water Distribution System was constructed at this site in 1999; however, it is not known whether the decrease in the number of plants between 1998 and 2000 was related to construction activities .

Due to the life history characteristics of this species and the lack of historical population data, it is difficult to accurately determine the population trend. Because the species is a small annual plant, population numbers or changes in these numbers do not necessarily reflect the health of the population. For example, fluctuation of population numbers by an order of magnitude or more from year to year, as has been observed at both the Polo Ranch (EO1) and Salvation Army (EO2b) sites, is not unusual for annual plants, and could be due to environmental factors such as rainfall or temperature. Because the population numbers vary greatly from year to year, habitat quality and quantity, and the degree and nature of the threats to the habitat, are more useful and accurate indicators of the status of the species.

Attempts to locate additional populations

Surveys of most remaining potentially suitable habitat throughout Scotts Valley and surrounding areas have been conducted by local botanists, and to date, no additional populations of Scotts Valley polygonum have been discovered. Because the rock outcrop areas in which Scotts Valley polygonum occurs are also home to two other Federally-listed endangered species, the Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*), and the Ohlone tiger beetle (*Cicindela ohlone*), these areas have been thoroughly surveyed. Although the individual Scotts Valley polygonum plants are small and only visible during the growing season, populations should be relatively easy to locate because the rock outcrops on which they grow are well-defined and readily identifiable in the field. It is possible that some privately-owned areas of potentially suitable habitat have not been surveyed because they are inaccessible. However, Mr. Randall Morgan, a long-time resident ecologist who is intimately familiar with the area, has thoroughly searched for suitable areas based on topographic maps and on-the-ground surveys. According to Mr. Morgan, most of the habitat likely to support Scotts Valley polygonum in this area has been developed, and it is highly unlikely that additional undeveloped areas with the potential to support the species exist (Morgan, pers. comm.).

The Department searched nine U.S. herbaria for historical records. Herbarium search information is on file with the Department. A literature search was also conducted. To

date, no references to any California populations of Scotts Valley polygonum other than the known localities in Scotts Valley have been located.

THREATS

Present or threatened modification or destruction of habitat

All known Scotts Valley polygonum occurrences are threatened by direct and indirect impacts due to development, including destruction of plants and/or their habitat; loss of pollinator or dispersal vector habitat; changes in surface hydrology; changes in water quality due to application of herbicides, pesticides and dust-reducing substances applied to adjacent areas; and soil siltation. In addition, proximity to developed areas can increase the risk of other related impacts such as human use of the habitat or invasion of non-native species; these threats are discussed separately below.

A housing development is currently in the planning stages for the Polo Ranch site (EO1). A draft Environmental Impact Report (EIR) was first circulated for this project in 1990. The property was subsequently sold to Lennar Communities/Greystone Homes (Greystone), and a second draft EIR was circulated in 2000. The project proposal is currently being reconfigured. Changes to the project since 2000 are substantial, and a new EIR may be required. Regardless of possible reconfiguration, the project will cause fragmentation of habitat and may result in secondary impacts to Scotts Valley polygonum. Secondary impacts may include encroachment of non-native plants; changes in hydrologic conditions; soil compaction and disturbance; application of herbicides, fertilizers, or pesticides near the Scotts Valley polygonum plants; and dumping of yard waste. If the polygonum requires insect pollination for reproduction , development of surrounding areas and potential loss of insect pollinator or seed dispersal vector habitat could have negative impacts on Scotts Valley polygonum.

Recent construction of Scotts Valley High School at the Scotts Valley School District site (EO2a) eliminated approximately 0.33 acre of rock outcrop areas that may have provided suitable habitat for Scotts Valley polygonum (BRG 1999b). The patch of Scotts Valley polygonum plants occurs approximately 60 feet (18 m) from the edge of the high school playing fields in the high school “preserve area” (Figure 10). The “preserve area” was required as mitigation for negative impacts to the federally-listed endangered Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*), the State-listed endangered San Francisco popcorn flower (*Plagiobothrys diffusus*), the federally-listed endangered Ohlone tiger beetle (*Cicindela ohlone*), and Scotts Valley polygonum that occurred during the construction of the high school. Although the “preserve area” is currently managed to protect these species, the long-term conservation of this habitat area is not guaranteed. The proximity of these Scotts Valley polygonum plants to developed areas subjects them to indirect impacts, such as changes in surface hydrology and water quality, invasion of non-native plants, soil disturbance and compaction, and possible vandalism. The 2002 Biotic Resources Group monitoring report for the preserve area stated that construction of the high school recreational fields has resulted in increased runoff entering the drainage swale on the grassland

Figure 10. Scotts Valley polygonum habitat adjacent to high school playing fields. *Photo by Melanie Gogol-Prokurat*

Figure 11. Scotts Valley polygonum habitat directly downslope from road at Salvation Army site. *Photo by Melanie Gogol-Prokurat*

preserve, and that erosion was noted along the edge of the preserve (BRG 2002).

At the Salvation Army site (EO2b), habitat destruction occurred during the construction of the Scotts Valley Water District Recycled Water Distribution System project in July, 1999. This project eliminated eight rock outcrop areas that may have provided suitable habitat for Scotts Valley polygonum (BRG 1999a). A buffer of at least 75 feet (23 m) was required between the Scotts Valley polygonum population and grading for the project according to the mitigation measures set forth in the Environmental Impact Report (EIR) under the California Environmental Quality Act (CEQA). Actual grading was out of compliance with the EIR, coming within 10 feet (3 m) of the Scotts Valley polygonum plants. The Scotts Valley Water District and the Department entered into negotiations in an attempt to address the CEQA violation. The Salvation Army, on behalf of the Scotts Valley Water District, offered the Department a conservation easement over 4.4 acres of the Salvation Army site. However, that conservation easement contained terms which were unacceptable to the Department. There is currently no long-term protection of this habitat area. The Scotts Valley polygonum plants are now located directly downslope from the road, which could result in a number of indirect impacts to the plants, including changes in surface hydrology and water quality, increase in soil siltation, soil compaction and disturbance, and invasion of non-native plants (Figure 11).

Overexploitation

No evidence of overexploitation of Scotts Valley polygonum has been observed at any of the occurrences. The Department concludes that overexploitation is not currently a threat to the survival or reproduction of Scotts Valley polygonum.

Predation

No evidence of predation has been observed at the Scotts Valley polygonum occurrences. The Department concludes that predation is not currently a threat to the survival or reproduction of Scotts Valley polygonum.

Competition

Field observations show that Scotts Valley polygonum appears to require relatively bare microhabitats with little or no competition from other plants in order to survive and reproduce. It is possible that Scotts Valley polygonum was not always restricted to the rock outcrop microhabitats, but the dense cover of non-natives in the surrounding grasslands has eliminated other potential colonization sites. McGraw and Levin (1998) found that a rare endemic species of *Chorizanthe*, also in the family Polygonaceae, is limited to the narrow edaphic conditions where it occurs due to competition and shade-intolerance rather than because of edaphic requirements. In her review, Dr. McGraw noted that her research on two other rare endemic plants in the region also found that they were demographically limited due to competition with non-native plants rather than because of specific habitat and/or edaphic requirements.

If Scotts Valley polygonum is a poor competitor, it may be particularly vulnerable to the invasion of non-native grasses from surrounding areas, which compete with native species for light, water, nutrients, and/or space. Although the rock outcrop areas where Scotts Valley polygonum occurs generally do not support abundant non-native species, the tall grasses found in nearby areas can negatively impact Scotts Valley polygonum by causing shading that would not normally be present, as well as contributing to the accumulation of thatch. Shading can inhibit the germination and growth of seedlings, and thatch buildup can change microhabitat conditions and suppress stored soil seedbanks. Similar factors have apparently impacted Santa Cruz tarplant (*Holocarpha macradenia*), another annual coastal grassland endemic (DFG files, unpublished).

Disturbance factors that have been identified at all sites, including foot traffic, and bicycle and off-road vehicle use, may facilitate an increase in non-native species within and around Scotts Valley polygonum habitat through soil disturbance and compaction, and transport and spread of non-native seed. Cessation of grazing can also result in increased abundance of non-native species. Cessation of grazing at the Polo Ranch site approximately ten years ago may have led to the disappearance of the State-listed endangered San Francisco popcornflower at that site, and may pose a similar threat to Scotts Valley polygonum (Hayes 2003). Although impacts of competition on Scotts Valley polygonum currently appear to be minimal, the level of threat could increase over time.

Disease

No evidence of disease has been observed on the Scotts Valley polygonum occurrences. The Department concludes that disease is not currently a threat to the survival or reproduction of Scotts Valley polygonum.

Other natural occurrences or human-related activities

Scotts Valley polygonum is threatened by natural events or human-related activities that could affect its ability to survive and reproduce. Impacts related to habitat fragmentation and inadequate design of preserve areas may disrupt the ecological function of the habitat areas, decreasing their ability to support and sustain populations of Scotts Valley polygonum. Soil compaction and disturbance due to human, bicycle, pet traffic, and off-road vehicle use may result in both direct and indirect impacts to the plants. Due to the small number of plants and small occupied area, the species is also at increased risk of suffering extinction from chance natural events.

Habitat fragmentation and inadequate design of preserve areas threaten the continued existence of the species through the disruption of ecological functions, which may lead to hydrologic changes; non-native plant invasions; and disruption of fire regimes, soil integrity, seed dispersal mechanisms, nutrient cycling, and plant-pollinator interactions. Habitat fragmentation has occurred recently with the construction of the high school (EO2a) and grading for the water district project (EO2b). The long-term effects of this fragmentation are not yet known. The development at Polo Ranch (EO1) will further

fragment habitat at that site, and inadequate buffers or preserve areas could jeopardize the species at that location.

Illegal off-road vehicle use is an ongoing problem, and can result in the damage or death of plants when they are run over, as well as cause soil disturbance, compaction, or erosion. Off-road vehicle use when the habitat is wet creates tracks and furrows through the mud, which can ultimately lead to the destruction and erosion of the rock outcrop habitat. Heavy off-road vehicle use is occurring at the Polo Ranch site (EO1) and the Salvation Army site (EO2b). Although a "no trespassing" sign is posted at the Polo Ranch site, off-road vehicle activity is a continuous problem because of an inability to lock a main access gate due to a private property right of way, the isolated nature of the property, and infrequent law enforcement patrol. The 2000 Polo Ranch EIR stated that the reduction in the number of plants between 1997 and 1998 may have resulted in part from effects of off-road vehicle use at the site (Impact Sciences, 2000). During a site visit in 2003, Department biologists observed a number of off-road vehicle and bicycle trails at the site (Figure 12).

Off-road motorbike and dirt bike trespass is a problem on the Salvation Army property (EO2b) despite fencing in the area, and there appears to be no enforcement. A dirt bike trail runs directly through one of the Scotts Valley polygonum habitat areas at this site, and although current activity does not yet appear to have significantly impacted the species, it is likely that damage to this site will occur over time (Kathy Lyons, pers. comm.) (Figure 13). During a site visit in 2003, Department biologists observed a person riding a motorbike through the Scotts Valley polygonum habitat area.

Soil disturbance and compaction by human, bicycle, and pet traffic are potential threats in the School District preserve area (EO2a). According to the most recent monitoring report for the preserve area, during 2001 and 2002, the preserve was subject to minor human disturbances, including students traversing the site and residents using the area for golf practice. During a site visit in 2003, Department biologists observed a number of golf balls within the preserve area.

The small number of plants and the small area of occupied habitat increase the risk of extirpation or extinction due to chance events. Total loss of one or more Scotts Valley polygonum occurrences could potentially be caused by wildfire, a new disease or insect pest, or failure or loss of pollinators. A single wildfire could eliminate part or all of the only known population of Scotts Valley polygonum in California. The response of Scotts Valley polygonum to fire is not known at this time. Use of the area by humans increases the risk of accidental fire. Because the Scotts Valley polygonum plants occur in close proximity to houses, emergency fire response, such as the creation of firebreaks, could also eliminate one or more patches of plants.

The reproductive potential and reproductive requirements of Scotts Valley polygonum are unknown at this time, and therefore the ability of the species to compensate for loss of plants due to degradation or destruction of habitat is also unknown. Population geneticists have determined that small populations are susceptible to genetic drift, loss

Figure 12. OHV trails near Scotts Valley polygonum occurrences at Polo Ranch site. *Photo by Melanie Gogol-Prokurat*

Figure 13. OHV Trail through Scotts Valley polygonum habitat at Salvation Army site. *Photo by Melanie Gogol-Prokurat*

of genetic variation, which can compromise their long-term survival (Gillespie 1998; Ellstrand & Elam 1993). In addition, small populations may be less effective in attracting the pollinators necessary for their reproductive success. Information on Scotts Valley polygonum pollinators and dispersal vectors and their life history requirements is currently lacking. Failure or loss of pollinators or dispersal vectors would likely lead to a decrease in the ability of the polygonum to reproduce.

Based on the findings above, the Department concludes that human activities and other natural events constitute a significant threat to the survival and reproduction of Scotts Valley polygonum.

ESSENTIAL HABITAT

Pursuant to Fish and Game Code Section 2074.6, the Department is required to make a preliminary identification of the habitat that may be essential to the continued existence of a species being considered for listing. Little is known about the ecological requirements of Scotts Valley polygonum and therefore, little is known about what constitutes essential habitat. Because Scotts Valley polygonum is limited to two occurrences occupying less than one acre of habitat, the Department currently identifies all existing occupied habitat as essential to the continued existence of the species. In her review, Dr. Holl emphasized that it is necessary to preserve not only the exact locations where Scotts Valley polygonum is found, but also a buffer area around the populations to minimize effects of fragmentation.

All known occurrences of this species are found within northern Scotts Valley, approximately seven miles (12 km) from the coast, at an elevation of 700-800 feet (215-246 m). The species occurs in coastal prairie grasslands on wave-cut coastal terraces underlain by uplifted marine sediment substrates. Scotts Valley polygonum appears to be associated with gently sloping to nearly level, fine-textured, shallow sandy loam soils, underlain by outcrops of Santa Cruz mudstone and Purisima sandstone. Very few potential habitat areas fitting the apparent soil and habitat requirements for this species remain. Little potential habitat remains within the Scotts Valley area due to urban development. Because the current and historical distribution of the species is generally limited to this area, it is unlikely that suitable habitat exists elsewhere.

The USFWS has designated critical habitat for Scotts Valley polygonum, which includes the two populations and surrounding habitat totaling approximately 287 acres (117 ha). The USFWS notes that because maintaining edaphic and hydrologic conditions is critical to the survival of the species, it was essential that the critical habitat include habitat upslope of the populations extending to the upper limit of the immediate watershed, and habitat downslope from the populations to the point where grassland habitat is replaced by forest habitats. Activities in the habitat upslope and downslope of the populations could impact the amount and timing of water available to the rock outcrop areas, and may affect edaphic conditions through deposition of soils, erosion, and destabilization of slopes. The Department concurs with the USFWS conclusion that

the currently occupied areas and surrounding habitat are essential to the continued survival of the species.

SPECIES MANAGEMENT

Current Management

The Polo Ranch occurrence (EO1) is not currently managed to protect the species. A "no trespassing" sign is posted at this location; however, off-road vehicle use continues to be a problem.

The Scotts Valley High School occurrence (EO2a) is contained within a 9-acre "preserve area" with a management plan and 10-year monitoring program. The management plan and monitoring program are part of the mitigation required for negative impacts to sensitive species that occurred during construction of the high school. Management actions outlined under this plan include the installation of boundary fencing, control of invasive species, and periodic mowing on portions of the site. However, the future funding and management of this area is unclear due to a lack of legally-binding documents.

The Salvation Army occurrence (EO2b) is currently managed under the Recycled Water Distribution System, Salvation Army Site Revegetation and Management Plan. The revegetation and management plan was developed as part of the mitigation for negative impacts that occurred during the construction of the recycled water distribution system. This plan includes the installation of boundary fencing, periodic mowing on portions of the site, revegetation, and erosion control measures. However, the specified 4.4 acre conservation easement has not been finalized. The finalization and implementation of the conservation easement would aid the long-term protection and management of this site.

Federal Status

On May 8, 2003, the USFWS listed Scotts Valley polygonum as Endangered under the Federal Endangered Species Act (FESA), and concurrently designated critical habitat for the species. However, listing under FESA does not provide Scotts Valley polygonum adequate protection because all occurrences of the species are on private lands where USFWS has limited jurisdiction. A federal nexus would be required in order for the species to receive any protection under the federal act.

Other Status

Scotts Valley polygonum is classified by the California Native Plant Society (CNPS) as 1B, meaning it is Rare or Endangered in California and elsewhere (CNPS 2001). Its Global and state ranking as tracked by the California Natural Diversity Database (CNDDB) are G1 (Less than 6 viable element occurrences OR less than 1000 individuals OR less than 2000 acres), and S1.1 (very threatened) (CNDDB 2003).

Although these rankings help show that the species is rare and may be in need of protection, they do not provide any official protection.

Potential Management Activities

A number of additional management activities could be implemented by the landowners/managers to provide benefits to Scotts Valley polygonum. The habitat is being negatively impacted by heavy recreational use (e.g., off-highway vehicles, bicycles) and further actions are needed to exclude trespassing and human use of the habitat. The construction of additional fencing or increased patrols of the area would benefit the polygonum.

Additional vegetation management activities, such as removal of non-native invasive plants with grazing, prescribed fire, or other methods could be implemented to reduce competition. In her review, Dr. McGraw recommended that small scale experimental research be used to examine the effects of exotic species management on the demographic performance of Scotts Valley polygonum. Other potential management activities include the development and implementation of a comprehensive monitoring plan to assess the current health of the population and help guide future management; research on ecological requirements including soils, seed viability, and germination requirements; research on the response of seeds and plants to fire and competition; and the supplemental collection of seed for long-term storage.

IV. CONCLUSION

Due to its extreme rarity and restricted nature, the Department concludes that Scotts Valley polygonum in danger of becoming extinct in the absence of special protection and management efforts; therefore, listing as endangered is warranted at this time.

There are only two populations of Scotts Valley polygonum in Scotts Valley, Santa Cruz County, California, less than one mile apart and occupying a total area of less than one acre. The total number of plants in the populations has ranged from 200-400 plants to 3500 plants from year to year. Because the species is a small annual plant, population numbers or changes in these numbers do not necessarily reflect the health of the population; fluctuations of population numbers by an order of magnitude or more from year to year is not unusual for annual plants, and could be due to environmental factors such as rainfall or temperature. Because the population numbers vary greatly from year to year, habitat quality and quantity, and the degree and nature of the threats to the habitat, is a more useful and accurate indicator for the status of the species. The two populations of Scotts Valley polygonum are threatened by habitat loss and degradation and other human-related activities. Competition with non-native plants may also be a factor affecting the viability of the populations. Scotts Valley polygonum is vulnerable to random natural and anthropogenic effects due to the small size of the populations and limited extent of occupied habitat.

V. RECOMMENDATIONS

PETITIONED ACTION

The Department recommends that the Commission:

1. Find that the listing of Scotts Valley polygonum (*Polygonum hickmanii*) as endangered is warranted at this time.

2. Publish notice of its intent to amend Title 14 CCR 670.2 to add Scotts Valley polygonum (*Polygonum hickmanii*) to its list of endangered species.

RECOVERY AND MANAGEMENT ACTIONS

The Department recommends the following actions. The Department should:

1. Continue to work with landowners, project proponents, local lead agencies and other interested parties to secure Scotts Valley polygonum and its habitat. Current management and land-use plans should be properly finalized and implemented. The 4.4 acre conservation easement on the Salvation Army site should be finalized, and efforts should be made to secure long-term legal protection of the Scotts Valley School District "preserve area". The Department should work with the City of Scotts Valley and landowners during the development and consideration of any proposed project at the Polo Ranch site, to ensure the protection and management of the Polo Ranch population. Preservation of a matrix of occupied and potentially suitable habitat will help allow the species to survive stochastic events and respond to varying changes in disturbance regimes. In her review, Dr. Holl emphasized that it is necessary to preserve not only the exact locations where Scotts Valley polygonum is found, but also a buffer area around the populations to minimize effects of fragmentation.

2. In cooperation with the California Native Plant Society and other interested parties, conduct additional focused surveys in areas of potentially suitable habitat in the Scotts Valley area, in an attempt to locate additional populations.

3. Consult with scientific experts to obtain the best available technical expertise to inform conservation and management decisions regarding Scotts Valley polygonum; and work with the landowners, local agencies and interested parties to develop a conservation strategy.

4. Coordinate with local fire departments to prevent disturbance during emergency fire response.

5. Work with the landowners to develop long-term monitoring programs at locations where needed, and to ensure that current long-term monitoring programs are

adequate to provide data on the health of Scotts Valley polygonum populations that will help guide further management actions and conservation methods. Extant populations should be monitored yearly and information submitted to the Department's California Natural Diversity Database.

6. Develop and implement adaptive management strategies in cooperation with landowners and land managers. The adaptive management program should respond to identified and potential threats to the species, including public access, off-road vehicle use, soil compaction and disturbance, increased erosion, trampling, competition, and wildfire.

7. Initiate fundamental research on aspects of the biology and ecology of Scotts Valley polygonum necessary to help guide management and recovery efforts, and seek funding to support investigations. Potential research needs identified to date include: reproductive and pollination ecology; factors determining seed viability and reproductive success, including seed dispersal and herbivory; habitat requirements of potential pollinators and dispersal agents; plant demographics; habitat and soil requirements; response to competition and management methods to reduce competition with non-native plants; long-term population trends; and genetic diversity of the species.

VI. ALTERNATIVES TO THE PETITIONED ACTION

Alternatives to the petitioned action include (1) list as threatened, or (2) decline to list.

Under CESA, "threatened species" means a native species or subspecies of bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by this chapter (Fish and Game Code, Section 2067). Listing as threatened conveys the same legal protection status under the California Endangered Species Act (CESA) and the California Environmental Quality Act (CEQA) as that of the petitioned action. Sources of potential funding for recovery, protection, and research are the same as those for designated endangered species. During environmental review under CEQA, threatened species are generally treated in a manner equivalent to endangered species with regard to mitigation. The CEQA Guidelines provide for a mandatory finding of significance requiring preparation of an Environmental Impact Report if a project may result in a reduction in numbers or restriction of range of a rare, threatened, or endangered species (CEQA Guidelines, Section 15065). In general, listing may encourage more funding for the species.

Declining to list would deny the species the specific legal protections of CESA. However, under CEQA, species such as Scotts Valley polygonum that meet the criteria for rare, threatened or endangered status are to be given treatment equal to the State-listed taxa (CEQA Guidelines, Section 15380). Fewer sources of funding are available for protection and recovery efforts for unlisted taxa.

The Department's California Natural Diversity Database (CNDDB) ranks this species as a G1/S1.1. G1 indicates that the global range of the species is limited to fewer than six viable element occurrences (EOs) OR fewer than 1000 individuals OR fewer than 2000 acres (CNDDB, 2003). The S1.1 designation indicates the species is very threatened in California, with fewer than 6 EOs OR has fewer than 1,000 individuals OR occupies fewer than 2,000 acres (CNDDB, 2003). The California Native Plant Society's *Inventory of Rare and Endangered Plants of California*, 6th edition (Tibor, 2001) lists the plant as a 1B, or "plants rare or endangered in California and elsewhere." The G1/S1.1 and List 1B designations for Scotts Valley polygonum will remain in effect regardless of action taken by the State.

Under CESA, "endangered species" means a native species or subspecies of bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease (Fish and Game Code, Section 2062). The Department recommends designating Scotts Valley polygonum as endangered, as requested in the petition. There are only two known occurrences of Scotts Valley polygonum, both of which have suffered substantial negative impacts due to destruction of habitat and human activities. On-going threats continue to jeopardize these populations. Due to the small number of plants at each occurrence and the limited extent of occupied area, both populations are at a high risk of extirpation. Because of the high level of present and potential threats to this species that may result in extirpation, the Department finds that endangered status is warranted for this species.

VII. PROTECTION RESULTING FROM LISTING

Protections afforded by listing include: (1) protections as specified in CESA and CEQA, and (2) increased likelihood for allocation of resources for research, protection and recovery activities.

The CEQA review process is designed to provide full disclosure of potential impacts resulting from proposed projects. When it is found that a proposed project may reduce the number or restrict the range of an endangered, rare, or threatened species, CEQA requires a mandatory finding of significance and preparation of an EIR.

State-listing allows access to special funding sources for protection, recovery and research activities. These programs are essential to improving the status of declining species. Projects designed to help State-listed species often benefit other species and habitats as well, and may improve the general ecological condition of an area, including urbanized areas, by providing open space and other amenities. Funding for State-listed species also can be used for educational programs. Educational programs focused on State-listed species encourage the general public to appreciate the values of preserving biological diversity and a healthy environment, which benefits all people.

REFERENCES

[BRG] Biotic Resources Group. 1999a. *Recycled Water Distribution System, Salvation Army Site, Scotts Valley Water District, Conceptual Habitat Mitigation Strategy*. Dated August 23, 1999.

[BRG] Biotic Resources Group. 1999b. *Scotts Valley High School Habitat Mitigation and Management Plan*. Dated September 7, 1999.

[BRG] Biotic Resources Group. 2002. *Scotts Valley High School, Habitat Mitigation and Management Program, Years 3 and 4 (2001 and 2002) Monitoring Report*. Dated December 15, 2002.

[CEQA] California Environmental Quality Act Guidelines. 2001. Consulting Engineers and Land Surveyors of California (CELSOC), Sacramento, California. 225 pp.

[CNDDB] California Natural Diversity Database, Wildlife & Habitat Data Analysis Branch, California Department of Fish and Game. March 29, 2004.

[CNDDB] California Department of Fish and Game, Natural Diversity Database. January, 2003. *Special Vascular Plants, Bryophytes, and Lichens List*. Biannual publication, Mimeo. 141 pp.

[CNPS] California Native Plant Society. 2001. *Inventory of Rare and Endangered Plants of California* (sixth edition). Rare Plant Scientific Advisory Committee, D. Tibor, Convening Editor. Sacramento, CA. x+388pp.

[DFG] Department of Fish and Game, Habitat Conservation Planning Branch, unpublished files.

Ellstrand, N. and D. Elam. 1993. Population genetic consequences of small population size: implications for plant conservation. *Annu Rev Ecol Syst* 24: 217-242.

Freeman, C. Herbarium Curator, University of Kansas. Personal Communication: Email to Melanie Gogol-Prokurat, Department of Fish and Game. March 3, 2003.

Gillespie, J. 1998. Population Genetics: A Concise Guide. The John Hopkins University Press, Baltimore, Maryland. 174 pp.

Hayes, G. 2002. A Petition to the State of California Fish and Game Commission to List Scotts Valley polygonum (*Polygonum hickmanii*) as an Endangered Species. 17 pp.

Hickman, J. (ed.). 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, California. 1400 pgs.

Hinds, H. and R. Morgan. 1995. *Polygonum hickmanii* (Polygonaceae), a New Species from California. *Novon* 5(4): 336.

Impact Sciences, Inc. 2000. *Draft Environmental SCH#1998041006, Volume I – DEIR Text*. Dated July 21, 2000.

Lyons, K. Botanical Consultant. Email to David Tibor, California Native Plant Society. November 21, 2002.

McGraw, J. and A. Levin. 1998. The roles of soil type and shade intolerance in limiting the distribution of the edaphic endemic *Chorizanthe pungens.* var. *hartwegiana* (Polygonaceae). *Madroño* 45(2): 119- 127.

Morgan, R. Ecologist. Personal communication with Melanie Gogol-Prokurat, California Department of Fish and Game. March 5, 2003.

State of California, Department of Fish and Game, and Fish and Game Commission. 2002. Fish and Game Code 2002 California Edition. LawTech Publishing Co., Ltd., San Clemente, California. 560 pp.

Tibor, D. (ed.). 2001. California Native Plant Society's Inventory of Rare and Endangered Plants of California, Sixth Edition. California Native Plant Society, Sacramento, California. 387 pp.

APPENDIX A: LANDOWNERS, MANAGERS, AND ADJACENT LANDOWNERS NOTIFIED BY THE DEPARTMENT

Ms. Lynn Joachim **(EO1)**
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Mr. Steve Fiss **(EO2a)**
Superintendent
Scotts Valley School District
4444 Scotts Valley Drive
Scotts Valley, California 95066

Ms. Jill Duerig **(EO2b)**
General Manager
Scotts Valley Water District
2 Civic Center Drive
Scotts Valley, California 95066

Captain Robert Lloyd **(EO2b)**
Salvation Army Division Headquarters
P.O. Box 193465
San Francisco, California 94119-3465

Mr. Mark Morton **(EO2b)**
Camp Redwood Glen Director
Salvation Army
3100 Bean Creek Road
Scotts Valley, California 95066

Ms. Jill Duerig **(EO2b)**
General Manager
Scotts Valley Water District
2 Civic Center Drive
Scotts Valley, California 95066

Mr. Philip Albuquerque
501 Navarra Drive
Scotts Valley, California 95066

American Dream/Glenwood LP
700 Emerson St.
Palo Alto, California 94301

Mr. Barry Barnett
715 Tiana Lane
Mountain View, California 94041

Mr. and Ms. Daniel and Robyn Beagle
6508 Los Gatos Hwy
Scotts Valley, California 95066

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APPENDIX B: AFFECTED AND INTERESTED PARTIES NOTIFIED BY THE DEPARTMENT

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APPENDIX C: PEER REVIEW ON PROPOSED LISTING

The following is a summary of the primary considerations raised in the comments received from two outside independent experts (peer reviewers). The peer reviewers were selected based on their scientific expertise as related to this species or its habitat, and their ability to offer an objective review. The Department solicited comments on completeness and accuracy of information, and whether the conclusions reached are reasonable based on this information, with respect to the status of Scotts Valley polygonum in California. Where appropriate, modifications to the document were made to respond to peer review comments. Comments are listed in the order that they were received.

1. Comments received from Dr. Karen D. Holl, Associate Professor, Environmental Studies Department, University of California, Santa Cruz to Mr. Ronald D. Rempel, Deputy Director, Habitat Conservation Division, California Department of Fish and Game, May 15, 2004. 1 page.

   Dr. Holl:

   - Found that the report is thorough and the evidence presented strongly supports the recommendation to list Scotts Valley polygonum as endangered.
   - Found that the information presented is consistent with her knowledge of the system.
   - Found that it is essential to protect both of the two known populations of this species, and emphasized that it is also necessary to preserve a buffer around the populations to minimize effects of fragmentation.
   - Concurred with the recommended management actions and noted that conducting ongoing monitoring will be particularly critical in the management of the species.

2. Comments received from Dr. Jodi McGraw, Plant Population Ecologist, University of California, Berkeley, to Mr. Ronald D. Rempel, Deputy Director, Habitat Conservation Division, California Department of Fish and Game, June 4, 2004. 4 pages.

   Dr. McGraw:

   - Found that the report provides a thorough assessment of available knowledge of the biology of the species and clearly outlines the causes and consequences of its rarity. She stated that she strongly supports the

findings in the report and concurs that the species warrants listing as endangered.

- Found that the species has exceedingly small population sizes, is of the rarest type of species, and its persistence is clearly threatened by habitat destruction, habitat degradation, and genetic erosion.

- Found that a comprehensive recovery strategy for the species will require research to determine its ecological requirements and test potential management techniques. She strongly recommended that the recovery actions outlined in the report be enacted expeditiously.

- Stated that the extraordinarily small populations of the species render it extremely vulnerable to extinction. She noted that natural occurrences such as drought, outbreak of herbivores or fungal pathogens, or insufficient cues for germination or seedling establishment, as well as anthropogenic events such as off-highway vehicle use, could reduce the populations and lead to extirpation or extinction.

- Cautioned that not all annual plants have a seed bank, and those species without a seed bank are especially vulnerable to extinction because their persistence requires that successive cohorts of plants establish, survive, and reproduce each year. Her research on a related species found that its seed storage is very limited.

- Noted that exotic plants may restrict the distribution of the species, and competition with exotics could result in negative population growth that leads to extirpation. She noted that like other narrow endemic plants restricted to rock outcrops, Scotts Valley polygonum is likely a poor competitor. Her research has shown that exotic plants restrict the distribution of two other endemic plants in the region. She recommended that small scale experimental research be used to examine the effects of potential management techniques to reduce exotic plant competition on Scotts Valley polygonum's demographic performance.

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15 May 2004

Ronald D. Rempel
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1416 Ninth St, 12th Floor
Sacramento, CA 95814

Dear Director Rempel,

I am writing in response to your request to provide comments on the draft status report for Scotts Valley polygonum (*Polygonum hickmanii*).

I have read the report and find it to be quite thorough and well written. The evidence presented strongly supports the recommendation to list *P. hickmanii* as an endangered under the California endangered species habitat. The fact that there are only two remaining populations of this species makes it essential to ensure their protection to have any chance of protecting this species. The information presented is consistent with my knowledge of the system and all the conclusions about the most important threats to the species follow logically from the data presented. I concur with the recommended management actions; ongoing monitoring will be particular critical given the high level of human impacts on these populations and the great interannual variability in annual plant populations in this climate. Under recommendation #1 it could be clearer that it is not only necessary to preserve the exact locations where *P. hickmanii* is found but also a buffer area around the populations to minimize the effects of fragmentation discussed earlier. I am unable to suggest additional sources of information on this species.

You may make my name public as a reviewer.

Sincerely,

Karen D. Holl

Karen Holl

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June 4, 2004

Ronald Rempel
Deputy Director
Habitat Conservation Planning Branch
California Department of Fish and Game
1416 9th Street, 12th floor
Sacramento, CA 95814

RE: Peer Review of the "Report to the Fish and Game Commission on the Status of Scotts Valley Polygonum (*Polygonum hickmanii*)"

Dear Mr. Rempel:

As a plant population ecologist, I reviewed your "Report to the Fish and Game Commission on the Status of Scotts Valley Polygonum (*Polygonum hickmanii*)". The report provided a thorough assessment of the available knowledge of the biology of this endemic plant and clearly outlines the causes and consequences of its rarity. Based on the information contained in the report and my knowledge of rare plant population biology, I strongly support the findings in your report and I concur with your conclusion:

> *Due to its extreme rarity, Scotts Valley Polygonum is in danger of extinction and requires special protection and management to persist. Therefore, state listing of this extraordinarily rare plant is warranted.*

Scotts Valley Polygonum is among the rarest of species. Its geographic range is exceptionally small—only 6 square kilometers in the entire world[1]. Within this area, Scotts Valley Polygonum is restricted to isolated patches of thin soil in fragments of coastal prairie grassland, such that its global distribution is a mere one acre. Within this extremely limited range, this plant has exceedingly small population sizes for an annual herb—only 404 individuals among three subpopulations as of the 2003 census. Based on the rarity classifications presented by Dr. Deborah Rabinowitz (1981), Scotts Valley polygonum is the rarest type of species.

Due to its extraordinary rarity and occurrence only on private land, the persistence of the Scotts Valley polygonum is clearly threatened by habitat destruction, habitat degradation, and genetic erosion. Additional habitat loss due to development would increase the probability of extinction of Scotts Valley polygonum. The habitat preserved at the Glenwood Hills site will not

[1] Using GIS, I drew a polygon containing the entire geographic area of the three populations based on Figure 8 of your report—it was 6.08 km^2.

likely be sufficient to conserve this species. With only three subpopulations and approximately 400 plants remaining, recovery efforts for this rare species will require more habitat be preserved.

As outlined in your report, Scotts Valley polygonum is threatened by habitat degradation, even within the single protected reserve. A comprehensive recovery strategy for this species will require research to determine the ecological requirements of this species and test potential management techniques to enhance its distribution and abundance. Concurrent with the listing as State Endangered, I strongly recommend that the recovery and management actions outlined in your report be enacted expeditiously.

In the absence of research on this rare species, there is clearly very little known about its ecology. My research examining the factors that influence the distribution and abundance of the rare Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*), a narrow endemic plant of the Santa Cruz County sandhills, may provide some insight into the conservation needs of this plant. Like the Scotts Valley polygonum, the Ben Lomond spineflower is narrow endemic annual plant in the Polygonaceae that is federally endangered, owing to the loss of habitat and degradation of remaining habitat. As is likely the case with Scotts Valley polygonum, the distribution and abundance of the spineflower is reduced by European annual grasses and forbs which decrease plant germination, survivorship, and fecundity (McGraw 2004a). Ongoing habitat destruction and degradation will likely prevent recovery of the federally endangered spineflower and preclude its long term population persistence (McGraw 2004b).

Compared with the Ben Lomond spineflower, however, which has relatively large population sizes (i.e. >100,000), the extraordinarily small remaining populations of Scotts Valley polygonum render it extremely vulnerable to extinction. Discrete natural occurrences such as a drought, an outbreak of herbivores or fungal pathogens, or insufficient cues and conditions for seed germination and/or seedling establishment, among other factors, could greatly reduce the already small populations. Similarly, anthropogenic events, including just a few moments of off-highway vehicle recreation, could reduce these populations. Exceptionally small populations such as those of the Scotts Valley polygonum are especially vulnerable to extirpation due to environmental stochasticity events. Given that there are only three subpopulations remaining, such extirpations could easily cause extinction of this rare plant.

While it is often assumed that most annual plants have a seed bank (underground store of dormant seed) which facilitates their persistence through unsuitable environmental conditions and disturbances, not all plant species have seedbanks. My research on the Ben Lomond spineflower indicated that seed storage is very limited in this plant and instead, population persistence requires that successive cohorts of plants establish, survive, and reproduce each year (McGraw 2004). As a result, it and other species without seedbanks can be especially vulnerable to extinction as a result of chance events (J. McGraw, unpublished manuscript).

Even in the absence of stochastic events, Scotts Valley polygonum populations could be extirpated as a result of negative population growth rates due to intense exotic plant competition. Like other narrow endemic plants restricted to rock outcrops, Scotts Valley polygonum is likely a poor competitor (Baskin and Baskin 1988). Though this plant may have always been restricted

to thin soils and bedrock outcrops, it is more likely that it historically occurred in other microhabitats within the coastal prairie, such as canopy gaps. Abundant, competitive European annual grasses and forbs may restrict the rare plant to the thin soils where exotic plants are not abundant.

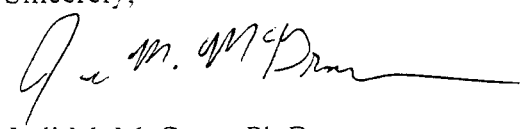
Exotic plants have been found to restrict the distribution of two narrowly endemic plants in the region: the rare serpentine jewelflower, *Streptanthus albidus* ssp. *peramoenus* (Green and McGraw, *in prep.*) and the Santa Cruz wallflower (*Erysimum teretifolium*), another Santa Cruz sandhills endemic (McGraw 2004a). Separate experiments examining the causes and consequences of the narrow distributions of these two endemic species showed that the jewelflower is restricted to rock outcrops by abundant European annual grasses that greatly reduce seedling establishment in the adjacent deep soils. Similarly, the wallflower is restricted to small, chronically disturbed soil erosion patches by European annual grasses and forbs in the sandhills. In both systems, the endangered plants exhibited higher demographic performance rates in the deeper soils where they are not commonly found than in the thin soils where they naturally occur, yet only when exotic plants were experimentally removed. These rare plants owe their highly restricted distributions within their unique edaphic habitats to exotic plant competition (Green and McGraw, *in prep.*, McGraw 2004a).

The description of the habit, habitat, and distribution and abundance patterns of the Scotts Valley polygonum provided in your report suggest that it too may be restricted to small patches of thin soil by exotic plants. I would recommend that small scale experimental research be used to examine the effects of potential management techniques to reduce exotic plant competition on the rare plant's demographic performance (*sensu* Pavlic et al. 1993). Such demographic approaches to rare plant ecology research were very effective in informing conservation and management of the Ben Lomond spineflower and Santa Cruz wallflower (McGraw 2004a, McGraw 2004b).

I would like to commend the Habitat Conservation Planning Branch for compiling a thorough report and recommending a series of coordinated recovery and management steps for the Scotts Valley polygonum. While it is unfortunate that it is the case, the extremely small geographic range, exceptionally narrow habitat specificity, and remarkably small population sizes of this narrowly endemic plant render it very straightforward to recommend that the plant be listed as State Endangered.

Thank you for the opportunity to comment on your report. Please do not hesitate to contact me if you have any questions or if I can be of further assistance.

Sincerely,



Jodi M. McGraw, Ph.D.

Plant Population Ecologist

Literature Cited

Baskin, C. A., and J. M. Baskin. 1988. Endemism in rock outcrop plant communities of the unglaciated eastern United States: an evaluation of the roles of edaphic, genetic, and light factors. Journal of Biogeography **15**:829-840.

Green, A., and J. M. McGraw. *in prep.* Exotic plants restrict the distribution of a rare endemic plant in serpentine grasslands. Abstract submitted for oral presentation at the annual meeting of the Ecological Society of America. Portland, OR. August 2004.

McGraw, J. M. 2004a. Interactive effects of disturbance and exotic species on the structure and dynamics of an endemic sandhills plant community. Doctoral Dissertation. University of California, Berkeley, California. 309 pages.

McGraw, J. M. 2004b. Sandhills Conservation and Management Plan. Report submitted to the Land Trust of Santa Cruz County, Santa Cruz, CA. 352 pages.

McGraw, J. M. The Effects of Fire and Anthropogenic Disturbances on Population Growth Projections for an Endangered Plant: The Importance of Seed Bank Demography. unpublished manuscript. December 2002.

Pavlik, B. M., D. L. Nickrent, and A. M. Howald. 1993. The recovery of an endangered plant I: Creating a new population of *Amsinckia grandiflora*. Conservation Biology 7:510-526.

Rabinowitz, D. 1981. Seven forms of rarity. Pages 205-217 *in* H. Synge, editor. The biological aspects of rare plant conservation. John Wiley and Sons, Ltd., New York.